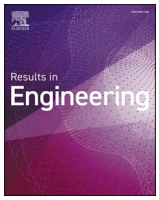
Results in Engineering 26 (2025) 104743

Contents lists available at ScienceDirect

Results in Engineering

journal homepage: www.sciencedirect.com/journal/results-in-engineering



Review article

The impact of artificial intelligence on research efficiency

Mitra Madanchian [a], Hamed Taherdoost [a,b,*]

[a] Department of Arts, Communications, and Social Sciences, School of Arts, Science and Technology, University Canada West, Vancouver, Canada
[b] GUS Institute | Global University Systems, London, United Kingdom

ARTICLE INFO

Keywords:
Machine learning
Research
Literature discovery
Data analysis
Writing assistance
Collaboration tools
Artificial intelligence
Natural language processing
AI ethics

ABSTRACT

Artificial intelligence (AI) is changing the research landscape through automation, data analysis, and better decision-making in various ways that are of immense help to researchers in conquering obstacles and accelerating their discoveries. From literature search to data analysis, to design experiments and manuscript writing, AI-powered tools using robotics, machine learning (ML), and natural language processing (NLP) go a long way in facilitating easy research. Technology enhances efficiency by summarizing articles, recommending publications, and pointing researchers in the right path. However, challenges such as bias in algorithms, concerns about data privacy, and deficiencies in the infrastructure impede wide-scale application. Training and supporting policies are needed for skill shortages and to surmount resistance to change in order for full utilization of AI in research. The present review has sought to explore how AI has influenced the efficiency of research through an analysis of its uses, advantages, disadvantages, and consequences across many fields. By examining the current tools and making projections on future trends, this study aims at educating academics, policymakers, and institutions on how AI might influence research in a fair and sustainable way.

1. Introduction

Artificial Intelligence (AI) has gained global acceptance as a technology that may improve our quality of life and spur economic growth. As a result, AI has been applied extensively across various social system sectors [1]. The term AI describes how a machine or system can mimic human intelligence. Creating a machine that can think and behave like a human—that is, learn, reason, plane, perceive, anticipate, and so forth—is the aim of AI. One of the primary traits that sets humans apart from other animals is intelligence. Human labor from all walks of life is being steadily replaced by a growing variety of machine kinds due to the endless occurrence of industrial revolutions. The next major obstacle to be surmounted is the imminence of machine intelligence replacing human resources [2].

Research efficiency is vital in academia and industry due to the fact that it facilitates better exploitation of resources and insightful knowledge production. Research efficiency plays a major role in knowledge development and the discovery of new technologies and methodologies within the academic circles. For instance, research work by Hanks [3], highlights the importance of efficiency in research through providing original research data and information that would be helpful for both industrial and academic researchers and graduates. Similarly, work by Torrence et al. [4] indicates that proper research in areas like risk assessment and antibiotic resistance has to be conducted in order to alleviate public concerns and ensure food safety. Efficiency in research is highly required to promote creativity, facilitate processes, and increase production in the industrial sector. With the development of wireless communication technologies, the interest in research areas has been enhanced, leading to an improvement in road safety and traffic efficiency [5]. Work by Pagone et al. [6] further emphasize the importance of research efficiency in promoting sustainability, providing insight into the state of the art in industrial practices and research subjects linked to energy-efficient processes. Liu et al. [7] epitomize the importance of research efficiency at developing fields such as that of edge computing systems. To investigate new research avenues and help users in choosing appropriate systems for particular applications, this survey study provided a comprehensive review of current edge computing programs and systems. On a related note, work by Zhen et al. [8] are keen to point out how there is an urgent need for exploring new research issues toward achieving maritime shipping networks and green ports with increased effectiveness and efficiency.

Many disciplines have shown interest in exploring the ways in which AI might enhance research productivity. For example, Hermens et al. [9] demonstrated the potential for significant innovation in teaching and

* Corresponding author.
E-mail address: hamed.taherdoost@gmail.com (H. Taherdoost).

https://doi.org/10.1016/j.rineng.2025.104743
Received 24 December 2024; Received in revised form 25 February 2025; Accepted 27 March 2025
Available online 10 April 2025

learning methods as they discussed how computer-based business simulations were being used in higher education to enhance the practical understanding of students regarding actual business scenarios. Similarly, Bhatti et al. [10] conducted a thematic analysis of literature on the use of AI in learning and development, emphasizing how the critical analysis and synthesis of past research can lead to the identification of key themes. Karimova et al. [11] conducted emotionalist interviews to comprehend how participants envision AI-based products such as Sophia, Alexa, and Articoolo in order to study the adaptation of anthropomorphism and archetypes regarding the marketing of these products. This research has shown how AI studies can be interdisciplinary, pointing toward the potential link between Jungian archetypes and AI products. To develop innovative ways to optimize resource use, improve energy management, and enhance monitoring and control systems, the contribution of AI in enhancing resource efficiency in urban infrastructure was reviewed by Lutfiani et al. [12]. This study shows the ability of AI technology to completely change the face of sustainability and management of urban infrastructure. Mahmud [13] explored the usability of AI in the automation of library cataloging and classification processes by reviewing current applications, challenges, and future possibilities. This paper contributes to the literature on how AI can enhance the efficiency and speed of library processes through a review of current studies and developments about AI applications in library services.

The objective of this review is to investigate the influence of AI on research efficacy by analyzing the ways in which AI technologies enhance various aspects of the research lifecycle. The paper examines the ways in which AI can automate repetitive duties, accelerate data analysis, and facilitate collaboration across disciplines. This work offers an exhaustive comprehension of the role of AI in the transformation of research processes by examining the existing literature and tools. The primary inquiries are as follows:

- How does AI enhance specific research activities such as literature review, data analysis, and experimentation?
- What are the current challenges and limitations in adopting AI for research purposes?
- What future opportunities exist for leveraging AI to further improve research efficiency?

The applications of AI in research are the main topic of this review, which covers a range of disciplines including the social sciences, humanities, engineering, science, technology, and mathematics (STEM). This review attempts to describe the revolutionary effect of AI on research efficiency, pinpoint gaps in existing techniques, and suggest avenues for further investigation by combining insights from literature. By doing this, it hopes to add to the expanding conversation on integrating AI into the field of academic and industry research.

2. Conceptual framework

2.1. AI tools and technologies in research

In several scientific fields, the potential of AI to supplement and partially automate research has generated intense discussions [14]. Over recent years, there has been increasing interest in the application of AI techniques and technology in research from a growing number of disciplines. The topic of the relationship between AI and marketing was explored by Peyravi et al. [15], as well as potential future applications for AI in marketing campaigns. Along related lines, Fredström et al. [16] highlighted some key future research directions in this field by discussing how AI-based analysis can track invention spread at scale on patent data. Sharpless et al. [17] investigated the future of AI in cancer research and care and brought forward significant opportunities and breakthroughs the use of AI opens in that very important field of medicine.

On the other hand, Chichekian et al. [18] discussed the prospects of AI-powered learning in the classroom, emphasizing the importance of measuring the effectiveness of AI-powered tools and the role of instructors in this aspect. In analyzing the role of AI in communication, Sundar et al. [19] reflected on the psychological implications of AI as a tool for communication and provided topics for future research in this area. Ramachandran et al. [20] reviewed the state of AI technologies in decision-making processes today and suggested future research topics in their discussion on AI-powered decision-making in management. Judit et al. [21] studied the use of AI tools in education and shed light on its potential to enhance educational procedures by investigating university instructors' opinions of AI integration. In addition, Dedema et al. [22] investigated the use and perception of generative AI tools by researchers in the digital humanities, thus providing valuable insights into how researchers adopt and evaluate these technologies. Finally, the Institute for AI and Fundamental Interactions (IAIFI) was presented by Thaler et al. [23], who have pointed out the importance of bringing physics intelligence into AI tools in order to solve challenging problems in physics. Wagner et al. [24] pointed to concerns with AI/machine learning tools by focusing on computational checklists and synthetic data that would foster repeatability and ethics considerations in AI/machine learning research.

2.2. Metrics for measuring research efficiency

For academic work to have a greater impact, research efficiency is essential. Research has demonstrated that effective search techniques that make use of relevant academic databases can greatly enhance the quality of systematic reviews and meta-analyses [25]. The quality of evidence synthesis is influenced by the search systems used, which also have an impact on the recall and accuracy of pertinent literature. In the corporate world, effective business modeling is essential for incorporating innovation into product development, especially in technology-driven industries. Businesses can preserve a strategic competitive edge and increase operational effectiveness by investing in business modeling technologies [26]. By simplifying procedures and enhancing data management, the use of AI tools such as ChatGPT has also been recognized as a way to improve organizational efficiency [27].

Numerous strategies exist for measuring research efficiency, which can be broadly divided into parametric and non-parametric approaches. Data Envelopment Analysis (DEA) is a non-parametric technique that compares the outputs of decision-making units to their inputs in order to assess how efficient they are. DEA is extensively used in a variety of fields, including as agriculture and education [28]. A parametric method that takes into consideration statistical noise in the data while estimating the efficiency frontier. Economic studies frequently employ SFA to gauge efficiency and productivity [29,30].

Various industries have shown an interest in exploring ways to investigate measures that can determine research effectiveness. With the aim of reducing operation and asset costs in demand-supply chains, Kaski et al. [31] focused on developing a method to guide the development of product structures as well as measure the difference between the various design alternative implementations. By relating the supply chain performance to the financial performance of an enterprise, Martin et al. [32] highlighted the relevance of enterprise effectiveness. A new methodology for computing a CSP index by using DEA was provided by Chen et al. [33], paving new paths for empirical CSP studies in the years to come. To put energy efficiency in the spotlight, Bianzino et al. [34] analyzed and compared a set of energy-related metrics adopted in communication networks studies. Uddin et al. [35] highlighted the importance of green data centers and the need to implement measures of Power Usage Effectiveness to evaluate data center performance and efficiency for cost and operational efficiency. To evaluate the effectiveness of information flows, Badenhorst et al. [36] studied the efficiency of information flow in supply chains and developed a conceptual framework of metrics and indicators. To provide guidelines for data center design and optimization, Zhou et al. [37] proposed application-level

measures for power usage effectiveness in data centers. To reflect practice efficiency features such as total EHR time and time on documentation, Sinsky et al. [38] proposed fundamental metrics of Electronic Health Record (EHR) utilization in the healthcare sector. These measures illustrate their use cases for many stakeholders. In their review of the importance of applying graph and network theory metrics to quantify connectivity in geomorphic systems, Wohl et al. [39] stressed that understanding the pattern of connectivity is essential for managing rivers. Through the integration of digital twins with green metrics, Corrado et al. [40] insisted on the need for a choral approach in order to make smart cities and structures address problems related to sustainability.

2.3. The relationship between AI and research processes

Recent research advocates for AI-based literature reviews, which is a review process where AI tools support multiple stages, including data analysis, literature search, and issue formulation. This approach can reduce the much-needed time and effort required for comprehensive reviews by a great extent [14]. Massive literature can be summarized with the help of natural language processing (NLP) algorithms, which helps academics to identify gaps and formulate new questions related to their studies [14,41]. Numerous studies show that AI can speed up a range of research processes, including data processing and literature reviews. A thorough study of the literature, for example, revealed that 26 studies cited time-saving as the most prevalent benefit of AI across disciplines [42]. AI frees researchers to work on more complex analyses by automating routine activities. In the peer-review process, for example, this can include the automation of initial scans of articles that might reject lower quality submissions before human review. With machine learning algorithms doing the complex content evaluations and identifying trends in large datasets, deeper engagement with research subjects is enabled [41].

New research suggests that while AI has many advantages, there are still open questions that need to be answered, especially with respect to long-term implications for methodological rigor and academic integrity [43]. AI's ability to analyze a wide range of datasets enables opportunities for multidisciplinary research, which may lead to innovative cross-disciplinary collaborations [41]. Jialiang et al. [44] have also explored how AI-algorithmic decision-making processes impact perceptions of procedural fairness by workers and found that AI decisions may lead to lower levels of perceived justice as compared to decisions made by human supervisors. In this direction, Mazingue [45] has aimed at highlighting the advantages and challenges of the implementation of AI in CRM systems by investigating the multifaceted impacts of AI in CRM. The role of AI in relationship breakdown was studied by Fu et al. [46] with particular attention to breakup procedures which have been made easier through computer-mediated communication. Chang et al. [47] examined how employees' propensity to adopt AI was affected by AI-driven technostress, highlighting the possible impact of technostress on AI adoption. Thottoli [48] examined how to use AI and ICT to improve auditing procedures, highlighting the significance of these technologies in enhancing audit procedures. Yahanda et al. [49] pointed out the applications of AI in the medical field by giving a narrative review and commenting on the current and possible future impacts of AI on spine surgery and research.

3. Enhancing research efficiency with AI

3.1. Literature discovery and review

The integration of AI into scholarly research has shown promising results in increasing precision and speed across a wide array of disciplines. Rodriguez et al. [50] discussed the impact of computational power and data availability on the application of AI in drug discovery and suggested legislative actions to address these challenges. Lai et al. [51] discuss how generative AI influences the design process and demonstrate how it may help in collecting and analyzing data. Santiago et al. [52] illustrate how AI technologies speed up procedures right from literature review to data analysis by text mining techniques while examining the use of writing aid tools in research. Singh [53] discussed how AI and machine learning are intrinsic to supply chain management, improving processes such as demand forecasting and making in-the-moment decisions. Molopa [54] underlined the potential of AI in enhancing academic research procedures by focusing on AI-based literature review adaption. Chukwuere [55] examined the potential implications on the use of generative AI chatbots for teaching, learning, and research processes within higher education. Al-Akayleh et al. [56] critically analyzed the usage of AI in surface chemistry and catalysis, emphasizing the revolutionary impacts of AI methods in this field. Table 1 outlines how AI enhances systematic reviews through different stages.

Summarizing systems fueled by AI will go through long scholarly texts to produce fastened understanding and analysis by summarizing the content into an easily comprehensible form. Knowledge of crucial themes and points can be derived from the contents using various NLP-based techniques; therefore, shortened versions of the content will not sacrifice relevant information. While dealing with an ever-increasing volume of data, AI summarizers have become necessary tools to help improve productivity and optimize workflows by releasing users from time-consuming reading assignments and allowing them to focus on key insights [61]. AI tools can support literature review work by conducting semantic analysis and text extraction, which are crucial to the effective integration of prior research [62].

AI also plays a critical role in citation management by automating the process of organizing references and guaranteeing correctness in formatting. Using sophisticated algorithms to evaluate citation networks, tools like Scite enable researchers to quickly identify pertinent publications and comprehend the context of citations, whether they confirm or contradict preexisting findings [62]. AI-powered citation management tools facilitate researcher accuracy when writing. This is facilitated by a feature for bibliographic record-keeping, automatic formatting into required styles, and identifying even the tiniest probabilities for plagiarism. All these means serve the purposes of assurance and acceleration of the scholarly work integrity check and further accelerate the process of publishing them [14]. An organized analysis of the ways in which AI tools improve the literature review process is provided in Fig. 1.

3.2. Experiment design and optimization

By enabling researchers to interactively query and analyze massive datasets, large language models (LLMs) like ChatGPT further improve these capabilities and streamline the review process while upholding quality standards [63]. The engineering design process is a multi-step, intricate procedure. AI techniques that have been found to be useful for automating and improving these processes include machine learning, deep learning, and optimization algorithms. Iteratively improving designs within predetermined parameters using methods like genetic algorithms and Bayesian optimization produces better results faster. The classification of AI applications according to design stages identifies underdeveloped fields where more study may result in important breakthroughs [64].

To find possible therapeutic targets and forecast interactions with drug candidates, AI algorithms examine enormous biological datasets. This feature allows for more focused approaches, which speeds up the drug discovery process. By forecasting pharmacokinetics and toxicity profiles, machine learning aids in trial design by assisting in the prioritization of lead compounds for additional testing. Through wearable technology, AI technologies make it easier to collect data from clinical studies, improving patient participation and expediting data management procedures [65].

Table 1
Role of AI in automating literature searches and systematic reviews.

Step	Description	AI Tools/Techniques	Benefits	References
Search Strategy Development	Analyzes literature to identify relevant keywords.	NLP	Improves search term accuracy.	[57]
Screening	Screens titles and abstracts with ML algorithms.	Machine Learning	Saves time and reduces workload.	[58,59]
Data Extraction	Automates extraction of study data.	AI Models (e.g., NER)	Reduces errors, boosts efficiency.	[60]
Data Synthesis	Synthesizes findings from multiple studies.	ML, Meta-Analysis Algorithms	Speeds up and enhances analysis.	[58]

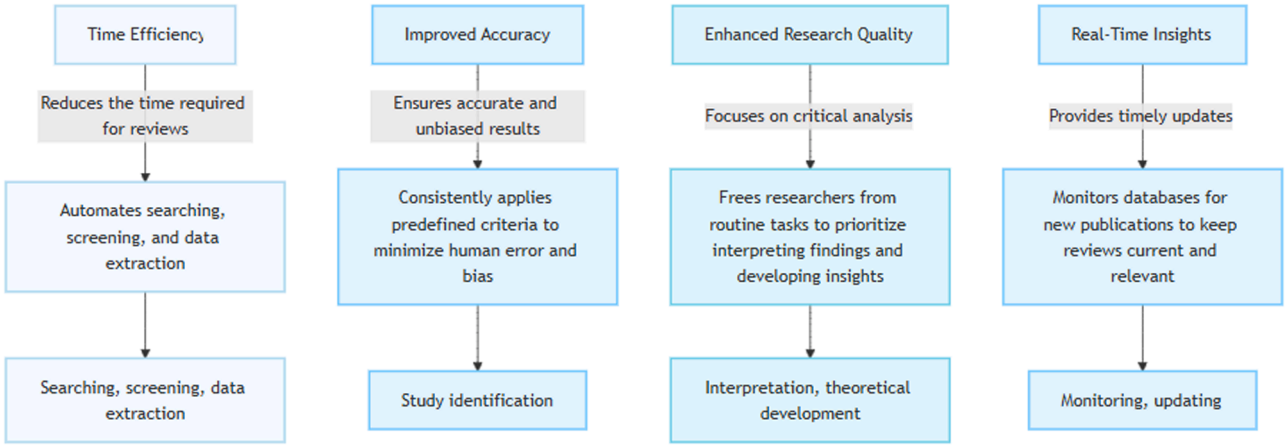


Fig. 1. The role of AI tools in enhancing literature reviews.

AI integration in a host of disciplines has been proven as having vast prospects for enhancements in both efficiency and productivity. Success stories and broadened perspectives on Generative Adversarial Neural Networks (GANs) coupled with advanced approaches using deep learning raise the quality of graphics samples gathered from research apparatus. This can help accelerate such scientific research and development, according to Striuk et al. [66]. Li et al. [67] show how AI can help in architectural design by enabling faster and more efficient completion of tasks, leading to better model fitting due to a greater number of network nodes. Chichekian et al. [18] highlight the importance of testing the effectiveness of AI-based technologies in education within an academic research framework. Their findings reveal that the active contribution of teachers is often overlooked in the research process, since learning outcomes are more closely related to the optimization of AI tools. Amzat et al. [68] explore the transformative potential of integrating AI and the metaverse into academic libraries, envisioning personalized and immersive user experiences that redefine conventional library concepts. In addition, the approach in Yang et al. [69] incorporates lithography bias into the design of neural networks to enable scalable AI computational lithography. This leads to a much more efficient model and great improvements in performance. The method is critical to enhance the printability of silicon in semiconductor manufacturing processes. Elufioye et al. [70] do a great in-depth study on the inclusion and the role of AI in supply chains in agriculture, while putting much attention to optimization in supply and demand prediction.

Yang et al. [71] emphasized developing an inductor model that evaluates the performance of printed meander line antennas in smart structures so as to reduce trial-and-error in the design process. Kim et al. [72] present the analysis procedure in the design of filters that minimize problems of stability and error rejection curve distortion in control systems. They suggested an adaptive and optimal method of rejection that aims to attenuate non-repeatable disturbances in hard disk drives. In ensuring completeness and optimality of the search algorithms, a technique by Yiu et al. [73] is introduced called Evolutionary Heuristic A search (EHA). It minimizes the work needed to construct heuristic functions and optimizes the performance of A* search through Genetic Algorithm (GA). Huang et al. [74] illustrated some applications of AI approaches for the forecast of aerodynamic coefficients in the aerospace industry by proposing aircraft shape design using artificial neural networks to simplify simulation analysis using CFD and wind tunnel trials. Fan et al. [75] present a discussion on AI-enabled simulation for power package development and underline how machine learning algorithms work well in solving problems with die pick-up procedures and reliability testing. Shiba et al. [76] show how AI agents can find the ideal parameters for solar cell devices to reach target efficiency by presenting an inverse design approach for optimal intermediate band solar cells using a deep reinforcement learning scheme in conjunction with a drift-diffusion simulator.

3.3. *Data analysis and statistical modeling*

Such technologies improve the effectiveness of literature retrieval by automating laborious activities such as searching, screening, and data extraction, freeing the researcher to devote more time to analysis rather than manual procedures [77]. Data analysis is highly influenced by AI. Machine learning algorithms can process large data sets more efficiently, identifying relationships and patterns that human researchers would not find. By gleaning valuable insights from surveys and interviews, NLP techniques further enhance qualitative data analysis [61].

AI tools can do work that normally takes several hours or days by humans in a fraction of the time. Due to this increased efficiency, more time can be spent actually analyzing data and developing new hypotheses [78]. The accuracy of literature reviews is guaranteed by automated tools by reducing human error and bias, and also ensuring that relevant studies are not missed out [77]. AI-powered solutions make excellent research techniques more accessible. They allow researchers of variable experience to conduct in-depth studies without requiring a great deal of prior information [79].

AI also plays a role in statistical modeling. Many studies discussed the effectiveness of machine learning models in predicting outcomes within the educational setting. For example, using feature selection methods such as Lasso regularization along with hyperparameter tuning, an exhaustive analysis of ten different machine learning models was performed for their effectiveness in predicting students' outcomes [80]. The importance of AI in research agendas was underlined by the

investigation of the application of AI in marketing through topic modeling and scientometric analysis by Mustak et al. [81]. The work of Almustafa et al. [82] had a core focus on the transformative effect that AI could bring to financial services, mainly regarding credit risk management in commercial institutions. Shoetan et al. [83] highlighted the use of advanced AI algorithms in fintech fraud detection with the aim of developing a reliable framework for real-time fraud prevention. While Khallaf et al. [84] focused on AI applications to the mitigation of the global warming problem, paying especial attention to optimization problems related to energy system optimization and climate modeling. Ulvi et al. [85] propose an urban traffic predictive analytics framework with a novel Urban Traffic Mobility Optimization Model - UTMOM and present mathematical modeling integrated with data mining in this paper. Rane et al. [86] discussed the function of AI in the improvement of resilience within different levels, focusing on the perspective of emergency management and disaster response. Broggi et al. [87] pointed out that the role of AI would be transformative in the diagnosis of head and neck cancer because of its enhanced capability in the analysis of medical images.

3.4. Data visualization

Tools for AI-assisted data visualization have changed how scientists examine and communicate difficult data. These tools can produce dynamic dashboards tailored to the user, more precisely forecast future trends, and automate the process of transforming unprocessed data into useful images. For example, AI systems can more quickly find abnormalities and hidden trends in big data than human experts. Interactive graphics combined with AI inspire problem-solving methods, therefore enhancing the interesting nature of data exploration [88,89].

Dealing with uncleaned or faulty data presents a major difficulty, though. Recent formative research underlines the influence of data quality on AI-assisted visualizations and stresses the requirement of strong instruments able to efficiently manage flawed data [90]. Notwithstanding these difficulties, developments in generative AI (GenAI) allow automatic generation of intricate visualizations from unprocessed data, therefore automating some aspects of corporate intelligence processes [91,92].

Synthetic image, tabular, textual, and audio data is produced using commonly applied techniques like Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and Transformers. Particularly useful for producing high-quality images with specified qualities are conditional GANs (cGANs). They are often utilized in medical imaging to improve diagnosis quality2. In healthcare or financial datasets, tabular GANs (TGANs) shine in capturing complex interactions between features. Conditional TGANs enhance upon this by efficiently managing challenging distributions. Because they can generate coherent text that fulfills contextual needs well 2, models such as GPT-3 provide better performance in natural language generating tasks [93].

3.5. Collaboration and communication

Literature reviews form one of the most fundamental parts of academic study, yet they are very time-consuming. Conventional approaches involve immense reading, note-taking, and data synthesis. AI tools have become enablers in this field. They considerably reduce the time that researchers would spend on such procedures by automating operations like searching, filtering, and extraction of data. For instance, AI-powered systematic review tools can search enormous volumes of literature for important publications and trends much faster and more accurately than any human could [84,94]. With the ability to continuously scan databases for new articles, AI tools provide real-time insights. This increases the overall quality of research outputs through the assurance of literature reviews remaining current and relevant [84]. The ability to detect gaps in the literature also engenders creativity through the generation of new research topics [84,95].

Beyond literature reviews, AI also influences data analysis, which is a huge part of scholarly research. Machine learning algorithms can process large datasets to find connections and patterns that would elude human researchers. NLP techniques make qualitative data analysis much easier; therefore, researchers can derive valuable insights from interviews and open-ended survey responses with greater efficiency [96]. According to a systematic review [96], the six key domains in which AI enhances academic writing are idea creation, content structuring, literature synthesis, data management, editing, and ethical compliance. By facilitating these processes, AI enables researchers to devote more time to critical analysis and discovering interpretation.

AI is also crucial in promoting the collaboration of researchers. GAI-powered tools facilitate the collaborative drafting and revising of texts. In a study on human-AI collaboration patterns, doctorate students who collaborated with GAI-powered tools performed better while writing compared to those who used them only as supplementary resources [68]. This therefore means that efficient human-AI collaboration may lead to better academic performances. AI serves to facilitate communication among the members of a research team by providing platforms for efficient sharing of ideas and results. High-quality research paper drafts and summaries were generated using tools like ChatGPT, which had better knowledge sharing in academia. However, questions concerning the integrity of AI-generated content are still present, so its use has to be considered with great care regarding ethical issues [97]. Sadeghi [98] proposes an AI-employee well-being interaction framework, highlighting that organizational strategies such as open communication and upskilling initiatives have great potential in mitigating negative and enhancing positive outcomes for employees in the era of AI.

4. Challenges and limitations

4.1. Ethical considerations

AI bias can be brought on by a number of different causes (Table 2). Data bias normally emanates from training datasets that are not representative in fairly depicting the diversity of those for whom they are intended to serve. This often leads to poor performance and biased forecasts in underrepresented groups [99,100]. Algorithmic bias is caused by the way algorithms are created and put into operation: they tend to support one kind of characteristic over another, which results in the outcome being unjust. For instance, algorithms that are prejudiced towards age or gender can lead to discriminatory employment practices [99,101]. Representation bias arises when datasets do not depict the population fairly. A typical case of this is medical databases where women are under-represented, leading to fewer correct diagnoses for them [99].

Bias in AI has a serious and multifaceted impact. Biased algorithms can lead to systematic discrimination against already-impoverished communities by making disparities worse. For example, predictive police algorithms have been shown to target low-income communities

Table 2
Types of bias.

Type of Bias	Issue	Cause	Impact	Reference
Historical Bias	Reflects societal biases	Present in historical data	Perpetuates discrimination when used in AI models	[102]
Sampling Bias	Inadequate representation	Training data collection not representative	Misaligned AI model predictions for the target population	[99]
Measurement Bias	Skewed results	Inaccuracies in data collection tools	Produces unreliable or distorted outcomes	[101]

disproportionately. Bias depletes trust in AI tools. Bad algorithms, according to research, may lead to biased decisions in critical areas such as law enforcement and healthcare, which will finally destroy the public's trust. Biased AI has serious ethical implications. There is an increasing demand for ethics and law frameworks that could control the development and application of AI so that negative consequences can be avoided [103].

LLMs are increasingly being used by paper mills, which are unofficial businesses that develop and market fake manuscripts that seem like real research, to produce compelling but fake papers [108,109]. LLMs are prone to "hallucinations", in which they produce information that is grammatically correct but illogical or deceptive. This problem makes it more difficult for academics to use AI-generated content to validate their findings. LLMs' references can be inaccurate or out-of-date, which would further erode public confidence in scientific publications [108].

Without sophisticated techniques, editors and journals find it challenging to detect faked content due to the complexity of AI-generated text [109]. Finding linguistic patterns or anomalies that differentiate machine-written from human-written content is the foundation of current techniques for detecting AI-generated writing. However, because of differences in writing styles and changing language models, these methods are not infallible [110,111].

Recent advances in large language models (LLMs) have raised concerns about AI-generated text detection, notably among academic institutions and publishers. Current detection tools claim excellent accuracy, but certain research suggest unreliability [112]. The paper by Májovský et al. [112] argues that detecting AI writing is wrong as it may lead to a technological arms race by improving AI writing tools. Since LLMs evolve quickly, detection methods may become obsolete. Prevention should be prioritized over detection because AI-generated text detection technologies are unreliable. This must also be communicated to educators. Instead, preventive pedagogical tactics for responsibly using generative AI technologies, including their pros and cons, should be discussed. Explaining and training students, instructors, and staff on ethical versus unethical AI tool use is crucial [113].

Academic research may be greatly affected by the EU AI Act. This law shapes the legal landscape for researchers who use AI techniques. The Act's focus on risk assessment and compliance may push AI researchers to use more rigorous methods, improving data quality and reliability [114]. However, bureaucratic impediments and compliance expenses may stifle innovation. AI in academic study has major ethical consequences. Generative models like ChatGPT have raised concerns about academic integrity and plagiarism [115]. AI tools must be used carefully to preserve research uniqueness. Data collection, processing, and use in research is complicated by the EU AI Act's data protection and privacy rules, especially in light of the GDPR [116].

Table 3
Issues related to intellectual property and authorship.

Topic	Key Issues	References
Ownership and Authorship Issues	- Debate over ownership of AI-generated content. - Question of whether training data use constitutes fair use. - Legal challenges, e.g., lawsuits against companies like OpenAI.	[104]
Existing Legal Frameworks	- IP laws inadequately address AI-related challenges. - Gaps in protection for original creators. - Need for adapting IP laws to safeguard creators and encourage innovation.	[105]
Bias and Fair Competition	- Biased datasets perpetuating inequalities. - Risk of overshadowing human-created content. - Importance of addressing biases for fair competition.	[106,107]

4.2. Technical barriers

There are numerous barriers to incorporating AI into existing research practices. Due to a general lack of technical knowledge to deploy AI tools, many researchers still underutilize or misapply these technologies [42,117]. Organizational complexity to manage change is yet another obstacle to overcome, as organizations may not be ready for new technology due to heavy procedures in place or inability to finance staff training for the new technology [117].

It sends up many ethical considerations with rapid application in research, most notably related to bias, privacy, and responsibility. As no standards have been established specifically shaped around the unique issues provided by the technology, REBs have often found themselves ill-prepared to review AI-driven initiatives, sometimes due to a sheer lack of knowledge in particular domains [118]. The ethical setting is further complicated by the lack of comprehensive regulatory frameworks, which put researchers at the risk of potential ethical violations when operating with AI [118,119]. Because researchers may grow accustomed to relying on AI-generated ideas without doing enough analysis, they may lose their ability to think critically and creatively as a result of this dependence [119].

Large, high-quality datasets must be available to AI applications if the latter are to function effectively. However, usability and interoperability issues in current workflows make it hard to access such datasets [120]. In many instances, integrating AI into existing research processes involves a great deal of expense and often requires significant enhancements in infrastructure. The need for advanced technology solutions to support AI applications is discussed in numerous research contributions. To ensure successful deployment, issues such as data validation, hardware specifications, and scalability of AI tools need to be addressed [42,120]. Blockchain technology has been one such suggestion to ensure data security and integrity in healthcare applications [121,122]. Irrespective of the increased capabilities of AI, human intervention also plays an important role. Incorrect conclusions may result from insufficient human intervention coupled with an increased reliance on the outcomes developed by AI. Many such studies have underlined the need for ethics guidelines or frameworks to reduce threats [123].

5. Comparative analysis of AI tools for research efficiency

An enormous amount of data must be processed for scientific study due to the exponential rise of data and the quick advancement of AI technology [124]. Chatbots driven by AI are becoming more and more common in a variety of sectors, including academia. There is, however, a dearth of empirical study on academicians' adoption practices [125]. Four top generative models are empirically benchmarked in the Morande [126] study. The systems' capacity to support 10 essential facets of scholarly research, from literature reviews to hypothesis creation, is assessed using standardized tests. Thematic study of the AI tools' viewpoints in conjunction with quantitative assessment of completeness, correctness, and relevance reveals subtleties between the systems' advantages, disadvantages, and validation requirements. Key findings indicate significant limitations in contextual adaptation, reasoning, and bias reduction, but promising competencies in targeted tasks like summarization. Although narrow augmentation seems possible at the moment, it is still difficult to totally automate scholarly work. To guide these technologies into responsible integration, the study provides important insights such as practical adoption strategies, governance agendas, and ethical issues. It also outlines potential avenues for future study, like improving logic and transparency.

AI is also supposed to enhance research processes. For instance, it helps in the development of the tool called rTutor.ai, which will give a hand in the generation of R code for statistical analysis in the field of academic writing [127]. The general use of AI in many fields across industries is further elaborated by the pharmaceutical industry that has

embraced its use in drug development, dosage form designs, and optimization [65]. Given its manifold uses in every facet, any expansion involving the use of AI would seriously affect security and risk management-a factor that the management cannot afford to miss. Documents such as the Executive Order on Safe, Secure, and Trust-worthy Development of AI-use guidelines point toward the need to develop the use of AI through articulated guiding principles and priorities [128]. In summary, the use of AI tools grouped by functions such as writing, data analysis, and teamwork—offers a plethora of chances for efficiency and creativity in a variety of sectors. With the integration of AI in operations such as cybersecurity, academic writing, and pharmaceutical technologies, organizations can enhance their capabilities and remain competitive in an increasingly digital world. While harnessing the power of AI solutions, the key issue remains one of security and risk management in order to protect against potential vulnerabilities and guarantee safe and secure operations [129–131].

There is an interest in the usage of AI in a lot of industries. The issues that the research community encounters due to the ever-increasing volume of scholarly literature and the inefficiencies of conventional manual research approaches were discussed by Müller et al. [132]. It is necessary to examine AI tools in order to enhance research productivity and extend the scope of research questions and data sources. Based on this, Rajagopal et al. [133] focused on how AI tools affect business performance and pointed out that without a systematic review of the literature, it would not be possible to understand how AI and marketing philosophy interact. The research aimed at developing a theoretical model from previous studies in the field, highlighting the importance of assessing AI tools on specific standards to achieve the desired research output. Shanbhag et al. [134] performed a blinded comparative analysis in evaluating the performance of AI in radiation oncology; this showed the advanced skills that AI performs in medical practices. As discussed by Marquis et al. [135], this AI tool has brought various changes in job dynamics, professional performance, and attitudes of society. It established that a generational divide exists regarding the adoption of AI; thus, while assessing the value of AI technologies with regard to academic research efficiency, user perceptions and level of engagement become an essential factor to consider. The review on AI-assisted scholarly writing tools by Martin-Boyle et al. [136] demonstrates the ways in which AI could be leveraged to organize information and produce relevant sections of the work in academic writing. Liu et al. [137] have provided an overview of research and educational uses of AI-assisted programming technology with a focus on underlying technology, performance evaluation, impacts, behavioral patterns, and ethical issues. Reddy et al. [138] discussed the potential of AI algorithms to further diagnostic procedures and improve patient outcomes, especially in healthcare related to coronary CT angiography for the management of coronary artery disease. Mostafapour et al. [139] presented a comparison between the literature reviews produced by the model ChatGPT-4 and the ones produced by human researchers, which calls for determination of the ability of the AI tools in producing quality research output.

These resources have different advantages and disadvantages which influence the direction and outcome of the research. The ability of AI tools to enhance the students' clinical practice and learning experience through facilitating the development of transferable skills is one of the advantages in academic research [140]. AI techniques can be helpful in areas such as forensics applications, as evidenced by stable isotopes used for many purposes, as shown in Chesson et al. [141]. However, AI techniques used in scholarly research also have some disadvantages. The practice of taking advantage of academic resources by administrative staff leads to unfair competition and hampers proper academic research activities [142]. As a result, competing for research projects may not be as easy for either teachers or researchers. Based on the distribution of the research topics, Ma et al. [143] propose a competitiveness-based approach for assessing research capability and ascertaining strengths and weaknesses of research institutes. This kind of analysis may help indicate the areas which need improvement and provide indicative information on the status quo of the field. Qasem [144] discusses the potential benefits and drawbacks of using ChatGPT and other language models for scholarly and scientific research. It is crucial that academics and students understand such implications while navigating the shifting landscape of AI technologies in academia.

6. Impact on different research disciplines

Because AI greatly improves the efficiency, accuracy, and depth of many scientific pursuits, it has completely changed the research environment. The technical aspects of AI are the main emphasis of this literature review, especially techniques that are essential for enhancing the performance of AI models, such as transfer learning, fine-tuning, and hyperparameter optimization. According to the transfer learning paradigm, previously trained models are modified for new tasks by drawing on their prior expertise. This method preserves excellent performance levels while cutting down on training time and data needs. For example, research has demonstrated that optimizing pre-trained language models, such as BERT and GPT, can yield impressive outcomes in tasks like sentiment analysis and text classification [145]. Transfer learning makes it possible to effectively modify pre-trained convolutional neural networks (CNNs) for certain image identification tasks in computer vision [146].

Changing a pre-trained model's parameters to suit a new task is known as fine-tuning. It works especially well when paired with strategies like prompt engineering or adapter tuning. Adapter tuning preserves performance similar to full-parameter fine-tuning while lowering computational costs by altering only a portion of the model parameters. By optimizing input prompts without changing the underlying model structure, prompt engineering enables effective adaptation to downstream tasks without requiring a significant amount of retraining [145, 147,148].

By choosing the best configuration settings that improve AI models' performance on particular tasks, hyperparameter optimization is essential to maximizing the models' potential. Although they are frequently employed, methods like grid search and random search can be computationally demanding. Recent developments include more effective hyperparameter optimization through the use of machine learning techniques itself [149].

6.1. STEM fields

AI significantly influences the learning of science, technology, engineering, and mathematics (STEM), particularly at the higher education level. AI has the potential to fully disrupt curriculum design, teaching methods, and student engagement. The study points out some key areas where AI enhances efficiency in education, such as automating administrative tasks and providing personalized learning experiences, freeing teachers to focus on strategic projects and enhancing operational efficiency [150].

Studies have shown that AI applications in most STEM subjects are quite diverse. AI enhances diagnosis processes in health by interpreting data and performing predictive analytics. It helps in generating research ideas and makes complex data analysis easier in the financial industry [151]. Some innovative learning tools, like the ISS or Intelligent Science Station, have been developed to engage students in active learning through the use of scientific methodology in real applications [152].

6.2. Medical research

Natural language processing and machine learning among other AI technologies are improving diagnosis accuracy, treatment protocol optimization, and administrative task simplification. The several effects of AI on research efficiency in different medical disciplines are investigated in this paper, therefore stressing both advantages and difficulties

of its application. Radiology is profoundly impacted by AI since it improves diagnosis capacity and automates picture interpretation. Research shows that radiology AI applications increase diagnostic accuracy and workflow efficiency, so perhaps lowering radiologist workload [153]. Still, questions about the ethical consequences of using AI tools and their dependability remain unresolved. Including AI in radiology presents difficulties including data quality problems and the need of strong validation procedures. Radiology diagnosis procedures have been demonstrated to be much improved by AI technologies. For example, faster diagnosis and better patient outcomes follow from machine learning algorithms' more rapid and accurate analysis of imaging data than more conventional techniques [154].

With AI technologies created to help with clinical decision-making, predictive analytics, and tailored treatment plans, the use of AI in oncology has gathered steam. Studies show that AI can improve the diagnosis accuracy for lung cancer, a disease marked by high morbidity and death rates [155]. Notwithstanding these developments, the general acceptance of AI in oncology confronts obstacles including data management issues and the need for clinical validation. Biassed data and a lack of consistent reporting techniques are among the various reasons why AI in oncology is hampered. These difficulties call for a cooperative approach among stakeholders to create efficient AI technologies that may be easily included into clinical procedures [156]. Constant learning and development for medical practitioners are crucial to guarantee the efficient application of AI technology in cancer [157].

The influence of AI goes beyond clinical work into medical education. According to a poll of postgraduate student doctors, most of them view AI's contribution to improve clinical training and education as somewhat favorable [157]. Although there were worries regarding its possible reduction of chances for gaining clinical judgement and practical abilities, respondents pointed out that AI might lower clinical workload and enhance research training.

6.3. Social sciences and humanities

AI technologies, in particular those based on NLP, have greatly improved qualitative analysis by automating what was previously done manually. Traditional qualitative analysis involves time-consuming and often very labor-intensive processes prone to human error, such as transcription, coding, and topic analysis. AI technologies can streamline these processes and free the academic to devote time to deeper analysis rather than drudgery. Cheligeer et al. [158] compared the results of conventional coding techniques with those from NLP in analyzing open-ended survey responses among people with chronic pain. While the authors have pointed out the limits of AI in extracting subtle concepts, their results indicated that NLP technologies not only increased efficiency but also improved thematic identification accuracy.

An AQUA developed by Lennon et al. [159] demonstrated a reduction in coding time by 75 % while providing insights on the relationships between topics that were not noted before. This work gives evidence of how AI is able to bring forth hidden patterns, therefore enhancing qualitative analysis. Harrison et al. [160] conducted a systematic literature review that emphasized the emerging trend of integrating AI tools to improve data processing and analysis skills, highlighting a variety of AI applications throughout qualitative research.

Most of the research that assesses the impact of AI on digital preservation and archival management has explored its integration within archival operations. AI technology enables better sorting and screening of historical documents, which is critical in handling big datasets and ensuring compliance with data protection legislation. Moss et al. [161] investigated how AI might affect archival practices, finding themes like improving access to archives and automating recordkeeping procedures. According to their research, AI introduces new approaches for organizing data, which calls into question established ideas of archive integrity including provenance and original order. AI can help archivists manage massive amounts of data while upholding ethical standards in data handling, according to a study by Chabin [162] that examined the application of AI for metadata creation in historical photo collections. In light of AI developments, Punzalan and Caswell's [163] work challenges conventional archive ideas, contending that these tools may be in opposition to archiving practices' objectives of diversity and inclusiveness.

6.4. Interdisciplinary research

Interdisciplinary study combines perspectives, methods, and knowledge from multiple disciplines to address complex issues. It aims to move beyond traditional boundaries among the disciplines and foster innovative approaches that may not be realized through single-discipline approaches. One systematic study identified various definitions and characteristics of interdisciplinary research, also discussing how it may merge different strengths of disciplines for the realization of new findings [164]. Recent research has shown how AI technologies, in particular ChatGPT, have transformed many fields of academia. In a systematic study, it has been found that ChatGPT has been used widely in areas such as computer science, healthcare, and education, proving its ability to support multidisciplinary research by enabling researcher communication and providing insights [165]. This integration of AI not only accelerates research processes but also encourages collaboration by bridging gaps in many academic areas.

Most of the interdisciplinary research approaches are enormously different; they often involve both qualitative and quantitative analyses in assessing teamwork. For instance, bibliometric techniques have been employed to identify recognized institutions and authors, and also to identify trends in mapping landscapes regarding AI applications across fields [165]. Interdisciplinary conferences are essential to the advancement of interdisciplinary research because they give academics from many domains a forum to exchange work and develop partnerships. In addition to promoting networking, these gatherings foster the sharing of ideas that may result in novel research findings [166].

7. Future directions

The future of AI in enhancing research efficiency is set to revolutionize both academic and industrial landscapes. Despite the significant progress made, the integration of AI into research workflows could be further influenced by a variety of emergent trends, policy considerations, and research opportunities. A promising trend is, among others, the rapid increase in the proficiency of generative AI models, state-of-the-art language models that develop coherent text, summarize complicated ideas, and produce academic articles. Such facilities are able to reduce the time taken for writing and editing by researchers by many orders of magnitude, leaving the researchers to devote much more time to conceptual and analytical work. With every passing year, AI models for text, image, and numerical data analysis are turning out to be increasingly effective instruments for interdisciplinary research. These models may allow breakthroughs in various fields, including bioinformatics, climate science, and social network analysis, among others, providing insights into a wide range of data. Table 4 focuses on the metrics related to time savings achieved by researchers using AI-assisted tools.

Table 4
Time savings with AI-assisted tools.

Study/Tool	Type of Task	Original Time	Reduced Time	Percentage Saved
Liu et al. [167]	Abstract Review	Variable	Up to 99.8 % reduction	Up to 99.8 %
Clark et al. [168]	Eligibility Screening	Manual: ~41h33m	Automated: ~11h48m	~72 %
Egunsola et al. [169]	Network Meta-Analyses Replication	Manual: Hours/Days	Automated: ~2 min	–

The integration of AI into research processes offers substantial benefits, including significant reductions in time spent on tasks such as literature screening and data extraction. While there is a notable lack of direct economic impact assessments from these efficiencies, indirect cost savings through manpower reduction are evident. As technology advances and trust barriers are addressed, we expect even greater adoption and quantification of these benefits.

Supportive policies are indispensable for AI to realize its maximum potential in improving research efficiency. The ethical, technical, and social challenges that are associated with the deployment of AI must be addressed by institutions and governments. Fostering inclusivity and reducing disparities between well-funded institutions and those in resource-constrained contexts necessitates guaranteeing that AI tools are accessible and affordable to researchers worldwide. Policies that support open-source AI tools can democratize access and allow researchers from all walks of life to leverage technological advancements. To prevent the misuse of AI in research, such as the generation of false or misleading data, policymakers need to set guidelines. Transparency in standards is necessary to ensure credibility and accountability in academic publishing regarding AI-generated content. It is also important to strengthen the legislation related to data privacy, which involves sensitive information, especially in healthcare and social sciences. Governments and funding agencies should provide resources for AI training programs that would provide researchers with the necessary expertise to apply these technologies efficiently. Acceleration of AI adoption and innovation in disciplines will be achieved through bridging the knowledge divide.

Few comparative studies exist that test the efficacy of multiple tools in different disciplines. These are aspects that need further research in order to find optimal practices for using these tools effectively [170, 171]. More longitudinal studies are needed in terms of assessing the long-term impact of AI integration on research quality and productivity. Understanding these will aid in the development of AI applications in scholarship. It would be interesting to review some researchers' experiences with these AI tools for valuable insights into usability issues that could inform the development of future tools. This way, a user-centered approach will ensure that tools adequately meet the needs of researchers. The relationship between AI and human creativity in research deserves further review in detail. While AI is excellent for automating mundane tasks, its contribution to creativity and innovation is yet to be determined. New dimensions of research productivity might be unleashed by investigating how AI can complement human ingenuity, rather than simply automating manual processes. For instance, the identification of synergies that enable transformative discoveries could be uncovered by analyzing the ways in which AI can contribute to hypothesis generation, problem-solving, and conceptual thinking.

8. Conclusion

AI integration into research workflows has revolutionized research productivity across various phases of the lifecycle. AI tools are making research faster, more accurate, and more collaborative, from literature discovery and data analysis to writing aid and collaboration. The use of AI in research is not without its challenges. AI ethics, output reliability, and tool accessibility remain some of the major challenges. These are the challenges that a researcher has to negotiate while using AI for boosting productivity.

AI solutions can speed up operations that are too time-consuming, automate repetitive tasks, and liberate the researcher to devote more time to critical thinking and new analyses. With AI-powered literature discovery services, rapid searches enable researchers to stay current with state-of-the-art studies. Researchers can make better decisions using various data analysis techniques that handle complex data sets. Writing assistants support researchers in maintaining high academic standards by increasing productivity and the quality of writing, while collaboration technologies enhance communication and teamwork, particularly in multi-disciplinary research projects.

Even with such advances, AI tools have their limitations. While they automate activities well, many technologies demand high levels of skill, making them less accessible to non-technical users. AI tools also create ethical issues related to authorship, data privacy, and AI-driven bias in research results. Researchers have to be cautious about information generated by AI and uphold academic integrity when integrating AI. In the future, AI is expected to rise in research efficiency. New trends, such as explainable AI models and decentralized collaborative platforms, should solve current issues. As AI develops, it could make research more efficient, ethical, and inclusive for the worldwide academic community.

CRediT authorship contribution statement

Mitra Madanchian: Writing – original draft, Resources, Methodology, Conceptualization. **Hamed Taherdoost:** Writing – review & editing, Visualization, Supervision, Software, Investigation.

Declaration of competing interest

"The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

References

[1] D.M. Heeg, L. Avraamidou, The use of artificial intelligence in school science: a systematic literature review, EMI. Educ. Media Int. 60 (2) (2023) 125–150.
[2] Y. Xu, et al., Artificial intelligence: a powerful paradigm for scientific research, Innovation 2 (4) (2021).
[3] G.R. Hanks, Narcissus and daffodil: the Genus Narcissus, CRC press, 2002.
[4] M.E. Torrence, R.E. Isaacson, Microbial Food Safety in Animal agriculture: Current Topics, John Wiley & Sons, 2008.
[5] E.C. Eze, S. Zhang, E. Liu, in: Vehicular ad hoc networks (VANETs): Current state, challenges, potentials and way forward. in 2014 20th international conference on automation and computing, IEEE, 2014.
[6] E. Pagone, K. Salonitis, M. Jolly, Energy-efficient casting processes, Innov. Manufact. Sustain. (2019) 77–98.
[7] F. Liu, et al., A survey on edge computing systems and tools, Proc. IEEE 107 (8) (2019) 1537–1562.
[8] L. Zhen, et al., Operation management of green ports and shipping networks: overview and research opportunities, Front. Eng. Manage. 6 (2) (2019) 152–162.
[9] A. Hermens, E. Clarke, Integrating blended teaching and learning to enhance graduate attributes, Education+ Training 51 (5/6) (2009) 476–490.
[10] P. Bhatt, A. Muduli, Artificial intelligence in learning and development: a systematic literature review, Eur. J. Train. Develop. 47 (7/8) (2023) 677–694.
[11] G.Z. Karimova, V.P. Goby, The adaptation of anthropomorphism and archetypes for marketing artificial intelligence, J. Consumer Market. 38 (2) (2021) 229–238.
[12] N. Lutfiani, et al., Ai-based strategies to improve resource efficiency in urban infrastructure, Int. Trans. Artif. Intell. 2 (2) (2024) 121–127.
[13] M.R. Mahmud, AI in automating library cataloging and classification, Library Hi Tech News (2024).
[14] G. Wagner, R. Lukyanenko, G. Paré, Artificial intelligence and the conduct of literature reviews, J. Inf. Technol. 37 (2) (2022) 209–226.
[15] B. Peyravi, J. Nekrošienė, L. Lobanova, Revolutionised technologies for marketing: theoretical review with focus on artificial intelligence, Business: Theory Pract. 21 (2) (2020) 827–834.
[16] A. Fredström, et al., Tracking innovation diffusion: AI analysis of large-scale patent data towards an agenda for further research, Technol. Forecast. Soc. Change 165 (2021) 120524.
[17] N.E. Sharpless, A.R. Kerlavage, The potential of AI in cancer care and research, Biochimica et Biophysica Acta (BBA)-Rev. Cancer 1876 (1) (2021) 188573.
[18] T. Chichekian, B. Benteux, The potential of learning with (and not from) artificial intelligence in education, Front. Artif. Intell. 5 (2022) 903051.
[19] S.S. Sundar, M. Liao, Calling BS on ChatGPT: reflections on AI as a communication source, Journal. Commun. Monogr. 25 (2) (2023) 165–180.
[20] K. Ramachandran, et al., AI-powered decision making in management: a review and future directions, in: 2023 3rd International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE), IEEE, 2023.
[21] M.T. Judit, T. Nikoletta, P. Monika, University teachers' perceptions of AI integration: insights from a qualitative focus group study, Opus et Educatio 10 (3) (2023).

[22] Dedema, M. and R. Ma, The collective use and evaluation of generative AI tools in digital humanities research: Survey-based results. arXiv preprint, 2024.
[23] J. Thaler, M. Williams, M. LaFleur, Institute for Artificial Intelligence and Fundamental Interactions (IAIFI): infusing physics intelligence into artificial intelligence, AI. Mag. 45 (1) (2024) 111–116.
[24] J.K. Wagner, et al., Synthetic data and ELSI-focused computational checklists—A survey of biomedical professionals' views, PLOS. Digit. Health 3 (11) (2024) e0000666.
[25] M. Gusenbauer, N.R. Haddaway, Which academic search systems are suitable for systematic reviews or meta-analyses? evaluating retrieval qualities of Google Scholar, PubMed, and 26 other resources, Res. Synth. Methods 11 (2) (2020) 181–217.
[26] M. Wilson, et al., A literature review on the effectiveness and efficiency of business modeling, E-Informatica Softw. Eng. J. 12 (1) (2018).
[27] M. Pradana, H.P. Elisa, S. Syarifuddin, Discussing ChatGPT in education: a literature review and bibliometric analysis, Cogent Ed. 10 (2) (2023) 2243134.
[28] A.S. Camanho, et al., A literature review of economic efficiency assessments using data envelopment analysis, Eur. J. Oper. Res. 315 (1) (2024) 1–18.
[29] O.B. Olesen, N.C. Petersen, Stochastic data envelopment analysis—A review, Eur. J. Oper. Res. 251 (1) (2016) 2–21.
[30] J. Odeck, Measuring technical efficiency and productivity growth: a comparison of SFA and DEA on Norwegian grain production data, Appl. Econ. 39 (20) (2007) 2617–2630.
[31] T. Kaski, J. Heikkila, Measuring product structures to improve demand-supply chain efficiency, Int. J. Technol. Manage. 23 (6) (2002) 578–598.
[32] P.R. Martin, J.W. Patterson, On measuring company performance within a supply chain, Int. J. Prod. Res. 47 (9) (2009) 2449–2460.
[33] C.M. Chen, M. Delmas, Measuring corporate social performance: an efficiency perspective, Prod. Oper. Manage 20 (6) (2011) 789–804.
[34] A.P. Bianzino, A. Raju, D. Rossi, Apple-to-apple: a common framework for energy-efficiency in networks, in: Proceedings of ACM SIGMETRICS, GreenMetrics workshop,(New York, NY, USA), 2010.
[35] M. Uddin, et al., Measuring efficiency of tier level data centers to implement green energy efficient data centers, Middle-East J. Sci. Res. 15 (2) (2013) 200–207.
[36] J.A. Badenhorst-Weiss, C. Maurer, T. Brevis-Landsberg, Developing measures for the evaluation of information flow efficiency in supply chains, J. Trans. Supply Chain Manage. 7 (1) (2013) 1–13.
[37] R. Zhou, Y. Shi, C. Zhu. AxPUE, Application level metrics for power usage effectiveness in data centers, in: 2013 IEEE International Conference on Big Data, IEEE, 2013.
[38] C.A. Sinsky, et al., Metrics for assessing physician activity using electronic health record log data, J. Am. Med. Inf. Association 27 (4) (2020) 639–643.
[39] E. Wohl, et al., Connectivity as an emergent property of geomorphic systems, Earth. Surf. Process. Landf. 44 (1) (2019) 4–26.
[40] C.R. Corrado, et al., Combining green metrics and digital twins for sustainability planning and governance of smart buildings and cities, Sustainability 14 (20) (2022) 12988.
[41] R. Butson, R. Spronken-Smith, AI and its implications for research in higher education: a critical dialogue, Higher Ed. Res. Develop. 43 (3) (2024) 563–577.
[42] I.M. Castillo-Martínez, et al., AI in higher education: a systematic literature review. Frontiers in Education, Frontiers Media SA, 2024.
[43] T. Ekundayo, Z. Khan, S. Nuzhat, Evaluating the influence of artificial intelligence on scholarly research: a study focused on academics, Hum. Behav. Emerg. Technol. 2024 (1) (2024) 8713718.
[44] P. Jialiang, et al., Can AI algorithmic decision-making improve employees' Perception of procedural fairness? Foreign Econ. Manage. 43 (11) (2021) 41–55.
[45] C. Mazingue, Perceived challenges and benefits of AI implementation in customer relationship management systems, J. Digitovation Inf. Syst. 3 (1) (2023) 72–98. -72–98.
[46] Y. Fu, et al., Should ChatGPT write your breakup text?. Exploring the Role of AI in Relationship Dissolution, 2024 arXiv preprint.
[47] P.C. Chang, et al., Does AI-driven technostress promote or hinder employees' artificial intelligence adoption intention? A moderated mediation model of affective reactions and technical self-efficacy, Psychol. Res. Behav. Manage (2024) 413–427.
[48] M.M. Thottoli, Leveraging information communication technology (ICT) and artificial intelligence (AI) to enhance auditing practices, Account. Res. J. 37 (2) (2024) 134–150.
[49] A.T. Yahanda, et al., Current applications and future implications of artificial intelligence in spine surgery and research: a narrative review and commentary, Global. Spine J. (2024) 21925682241290752.
[50] M. Rodriguez, et al., Bioinformatics algorithms for molecular docking: IT and chemistry synergy, Asia Pacific J. Energy Environ. 5 (2) (2018) 113–122.
[51] Y.R. Lai, H.J. Chen, C.H. Yang, Exploring the impact of generative artificial intelligence on the design process: opportunities, challenges, and insights, Artif. Intell., Social Comput. Wearable Technol. 113 (2023) 49–59.
[52] C.S. Santiago Jr, et al., Utilization of writing assistance tools in research in selected higher learning institutions in the philippines: a text mining analysis, Int. J. Learn., Teach. Ed. Res. 22 (11) (2023) 259–284.
[53] P. Singh, Digital transformation in supply chain management: artificial intelligence (AI) and machine learning (ML) as catalysts for value creation, Int. J. Supply Chain Manage. 12 (6) (2023) 57–63.
[54] S.T. Molopa, Artificial intelligence-based literature review adaptation, South Afr. J. Libraries Inf. Sci. 90 (2) (2024) 1–18.
[55] J.E. Chukwuere, B.L. Handoko, The future of generative AI chatbots in higher education, J. Emerging Technol. 4 (1) (2024) 36–44.
[56] F. Al-Akayleh, et al., A mini review on the applications of artificial intelligence (AI) in surface chemistry and catalysis, Tenside Surfactants Detergents (0) (2024).
[57] A.E. Kwabena, et al., An automated method for developing search strategies for systematic review using natural language processing (NLP), MethodsX 10 (2023) 101935.
[58] C.F. Atkinson, Cheap, quick, and rigorous: artificial intelligence and the systematic literature review, Soc. Sci. Comput. Rev. 42 (2) (2024) 376–393.
[59] R. Van Dinter, B. Tekinerdogan, C. Catal, Automation of systematic literature reviews: a systematic literature review, Inf. Softw. Technol. 136 (2021) 106589.
[60] N. Guler, S.N. Kirshner, R. Vidgen, A literature review of artificial intelligence research in business and management using machine learning and ChatGPT, Data Inf. Manage (2024) 100076.
[61] M. Khalifa, M. Albadawy, Using artificial intelligence in academic writing and research: an essential productivity tool, Comput. Methods Programs. Biomed. Update (2024) 100145.
[62] M. Glickman, Y. Zhang, AI and generative AI for research discovery and summarization, Harv. Data Sci. Rev. 6 (2) (2024).
[63] N. Fabiano, et al., How to optimize the systematic review process using AI tools, JCPP. Adv. 4 (2) (2024) e12234.
[64] P.M. Khanolkar, A. Vrolijk, A. Olechowski, Mapping artificial intelligence-based methods to engineering design stages: a focused literature review, AI EDAM 37 (2023) e25.
[65] L.K. Vora, et al., Artificial intelligence in pharmaceutical technology and drug delivery design, Pharmaceutics (7) (2023) 15.
[66] O. Striuk, Y. Kondratenko, Generative adversarial neural networks and deep learning: successful cases and advanced approaches, Int. J. Comput. 20 (3) (2021) 339–349.
[67] H. Li, et al., Exploration of the intelligent-auxiliary design of architectural space using artificial intelligence model, PLoS. One 18 (3) (2023) e0282158.
[68] O.B. Amzat, A.A. Adewojo, Metaverse-infused academic libraries: a glimpse into the future, Library Hi Tech News 40 (10) (2023) 17–19.
[69] H. Yang, H. Ren, Enabling scalable AI computational lithography with physics-inspired models, in: Proceedings of the 28th Asia and South Pacific Design Automation Conference, 2023.
[70] O.A. Elufioye, et al., Ai-driven predictive analytics in agricultural supply chains: a review: assessing the benefits and challenges of ai in forecasting demand and optimizing supply in agriculture, Comput. Sci. IT Res. J. 5 (2) (2024) 473–497.
[71] S.M. Yang, C.H. Huang, An inductor model for analyzing the performance of printed meander line antennas in smart structures, J. Electromagnetic Anal. Appl. 6 (09) (2014) 244.
[72] Y. Kim, C. Kang, M. Tomizuka, Adaptive and optimal rejection of non-repeatable disturbance in hard disk drives, in: IEEE/ASME (AIM) International Conference on Advanced Intelligent Mechatronics, 2005.
[73] Y.F. Yiu, J. Du, R. Mahapatra, Evolutionary heuristic a* search: heuristic function optimization via genetic algorithm, in: 2018 IEEE First International Conference on Artificial Intelligence and Knowledge Engineering (AIKE), IEEE, 2018.
[74] D.C. Huang, et al., Aircraft shape design using artificial neural network, Sensors Mater. (2020) 32.
[75] H. Fan, P. Yao, H. Chen, Application of AI-enabled simulation in power package development, in: 2023 24th International Conference on Thermal, Mechanical and Multi-Physics Simulation and Experiments in Microelectronics and Microsystems (EuroSimE), IEEE, 2023.
[76] K. Shiba, et al., Inverse design of intermediate band solar cell via a joint drift-diffusion simulator and deep reinforcement learning scheme, Jpn. J. Appl. Phys. 62 (2023) SK1046. SK.
[77] P.H. Ilegbusi, The integration of artificial intelligence (AI) in literature review and its potentials to revolutionize scientific knowledge acquisition, AfricArXiv (2024).
[78] H. Al Naqbi, Z. Bahroun, V. Ahmed, Enhancing work productivity through generative artificial intelligence: a comprehensive literature review, Sustainability. 16 (3) (2024) 1166.
[79] I.H. Sarker, AI-based modeling: techniques, applications and research issues towards automation, intelligent and smart systems, SN. Comput. Sci. 3 (2) (2022) 158.
[80] H. Farhood, et al., Evaluating and enhancing artificial intelligence models for predicting student learning outcomes. Informatics, MDPI, 2024.
[81] M. Mustak, et al., Artificial intelligence in marketing: topic modeling, scientometric analysis, and research agenda, J. Bus. Res. 124 (2021) 389–404.
[82] E. Almustafa, A. Assaf, M. Allahham, Implementation of artificial intelligence for financial process innovation of commercial banks, Revista de Gestão Social e Ambiental 17 (9) (2023) e04119.
[83] P.O. Shoetan, B.T. Familoni, Transforming fintech fraud detection with advanced artificial intelligence algorithms, Finance. Account. Res. J. 6 (4) (2024) 602–625.
[84] A.N. Khallaf, Using Ai to help reduce the effect of global warming, Power Syst. Technol. 48 (1) (2024) 1927–1947.
[85] H. Ulvi, M.A. Yerlikaya, K. Yildiz, Urban traffic mobility optimization model: a novel mathematical approach for predictive urban traffic analysis, Appl. Sci. 14 (13) (2024) 5873.
[86] N. Rane, S. Choudhary, J. Rane, Artificial intelligence for enhancing resilience, J. Appl. Artif. Intell. 5 (2) (2024) 1–33.
[87] G. Broggi, et al., Artificial intelligence in head and neck cancer diagnosis: a comprehensive review with emphasis on radiomics, histopathological, and molecular applications, Cancers. (Basel) 16 (21) (2024) 3623.

[88] L. Chen, et al., An artificial intelligence based data-driven approach for design ideation, J. Vis. Commun. Image Represent. 61 (2019) 10–22.
[89] S.K. Jagatheesaperumal, et al., The duo of artificial intelligence and big data for industry 4.0: applications, techniques, challenges, and future research directions, IEEE Internet. Things. J. 9 (15) (2021) 12861–12885.
[90] R. Saber, A. Fariha, Formative study for AI-assisted data visualization (2024) arXiv preprint.
[91] N. Jhanjhi, I.A. Shah, S. Nawaz, Generative AI for visualization. Generative AI for Web Engineering Models, IGI Global, 2025, pp. 63–82.
[92] H.K. Channi, A. Kaur, S. Kaur, AI-driven generative design redefines the engineering process. Generative Artificial Intelligence in Finance: Large Language Models, Interfaces, and Industry Use Cases to Transform Accounting and Finance Processes, 2025, pp. 327–359.
[93] M. Goyal, Q.H. Mahmoud, A systematic review of synthetic data generation techniques using generative AI, Electronics (Basel) 13 (17) (2024) 3509.
[94] Y.C. Tseng, Y.H. Lin, Enhancing English as a foreign language (EFL) learners' Writing with ChatGPT: a university-level course design, Electr. J. E-Learn. 22 (2) (2024) 78–97.
[95] I. Adeniran, et al., Integrating data analytics in academic institutions: enhancing research productivity and institutional efficiency, Int. J. Appl. Res. Soc. Sci. 6 (8) (2024).
[96] H. Calamur, R. Ghosh, Adapting peer review for the future: digital disruptions and trust in peer review, Learned Publ. 37 (1) (2024) 49–54.
[97] A.O. Adewusi, et al., AI in precision agriculture: a review of technologies for sustainable farming practices, World J. Adv. Res. Rev. 21 (1) (2024) 2276–2285.
[98] S. Sadeghi, Employee Well-being in the Age of AI: Perceptions, Concerns, Behaviors, and Outcomes, 2024 arXiv preprint.
[99] E. Ferrara, Fairness and bias in artificial intelligence: a brief survey of sources, impacts, and mitigation strategies, Science 6 (1) (2023) 3.
[100] González-Sendino, R., et al., A review of bias and fairness in artificial intelligence. 2023.
[101] J. Delgado, et al., Bias in algorithms of AI systems developed for COVID-19: a scoping review, J. Bioeth. Inq. 19 (3) (2022) 407–419.
[102] L. Belenguer, AI bias: exploring discriminatory algorithmic decision-making models and the application of possible machine-centric solutions adapted from the pharmaceutical industry, AI. Ethics 2 (4) (2022) 771–787.
[103] N. Pasipamire, A. Muroyiwa, Navigating algorithm bias in AI: ensuring fairness and trust in Africa, Front. Res. Metr. Anal. 9 (2024) 1486600.
[104] S. Chesterman, Good models borrow, great models steal: intellectual property rights and generative AI, Pol. Society (2024) puae006.
[105] A. Ubaydullayeva, Intellectual property in the era of artificial intelligence: challenges and solutions, Uzbek J. Law Digital Policy (3) (2023) 1.
[106] A. Przegalinska, T. Triantoro, Converging Minds: the Creative Potential of Collaborative AI, CRC Press, 2024.
[107] Alvarez, A., Assessing copyright infringement and moral rights violations: the impact of artificial intelligence on authors and visual artists in the creative industries.
[108] E. Chetwynd, Ethical use of artificial intelligence for scientific writing: current trends, J. Human Lactation 40 (2) (2024) 211–215.
[109] G. Kendall, J.A. Teixeira da Silva, risks of abuse of large language models, like ChatGPT, in scientific publishing: authorship, predatory publishing, and paper mills, Learned Publ. 37 (1) (2024).
[110] M. Al-kfairy, et al., Ethical Challenges and Solutions of Generative AI: An interdisciplinary perspective. in Informatics, Multidisciplinary Digital Publishing Institute, 2024.
[111] Y.J. Chen, V.K. Madisetti, Information security, ethics, and integrity in LLM agent interaction, J. Inf. Secur. 16 (1) (2024) 184–196.
[112] M. Májovský, et al., Perfect detection of computer-generated text faces fundamental challenges, Cell Rep. Phys. Sci. 5 (1) (2024).
[113] D. Weber-Wulff, et al., Testing of detection tools for AI-generated text, Int. J. Ed. Integrity 19 (1) (2023) 1–39.
[114] A.J. Blatch-Jones, H. Church, K. Crane, Exploring the potential benefits and challenges of artificial intelligence for research funding organisations: a scoping review, medRxiv (2024), 2024.09. 26.24314280.
[115] M.Z. Kapsali, et al., Ethical concerns about ChatGPT in healthcare: a useful tool or the tombstone of original and reflective thinking? Cureus 16 (2) (2024).
[116] Sartor, G. and F. Lagioia, The impact of the general data protection regulation (GDPR) on artificial intelligence. 2020.
[117] A. Mohammad, B. Chirchir, Challenges of integrating artificial intelligence in software project planning: a systematic literature review, Digital 4 (3) (2024) 555–571.
[118] S. Bouhouita-Guermech, P. Gogognon, J.C. Bélisle-Pipon, Specific challenges posed by artificial intelligence in research ethics, Front. Artif. Intell. 6 (2023) 1149082.
[119] F. Fui-Hoon Nah, et al., Generative AI and ChatGPT: Applications, Challenges, and AI-Human Collaboration, Taylor & Francis, 2023, pp. 277–304.
[120] M.I. Ahmed, et al., A systematic review of the barriers to the implementation of artificial intelligence in healthcare, Cureus (10) (2023) 15.
[121] S.M. Williamson, V. Prybutok, Balancing privacy and progress: a review of privacy challenges, systemic oversight, and patient perceptions in AI-driven healthcare, Appl. Sci. 14 (2024), https://doi.org/10.3390/app14020675.
[122] H. Taherdoost, Privacy and security of blockchain in healthcare: applications, challenges, and future perspectives, Science 5 (2023), https://doi.org/10.3390/sci5040041.
[123] X. Zhai, et al., A review of artificial intelligence (AI) in education from 2010 to 2020, Complexity. 2021 (1) (2021) 8812542.
[124] B. Wang, et al., The practice of enhancing learning and scientific innovative abilities using llm-based AI tools, in: in 2024 6th International Conference on Computer Science and Technologies in Education (CSTE), IEEE, 2024.
[125] V. Soodan, et al., AI chatbot adoption in academia: task fit, usefulness and collegial ties, J. Inf. Technol. Ed. Innov. Pract. 23 (2024) 1.
[126] Morande, S., Benchmarking Generative AI: a comparative evaluation and practical guidelines for responsible integration into academic research. Available at SSRN 4571867, 2023.
[127] Y.K. Dwivedi, et al., Opinion Paper:"so what if ChatGPT wrote it?" multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy, Int. J. Inf. Manage 71 (2023) 102642.
[128] Biden, J.R., Executive order on the safe, secure, and trustworthy development and use of artificial intelligence. 2023.
[129] T. Li, J.P. Higgins, J.J. Deeks, Collecting data, Cochrane Handbook Syst. Rev. Interventions (2019) 109–141.
[130] H. Taherdoost, Insights into cybercrime detection and response: a review of time factor, Information 15 (5) (2024) 273.
[131] A.A.o.C.o. Nursing, The essentials: core competencies for professional nursing education (2021).
[132] H. Müller, et al., The application of artificial intelligence on different types of literature reviews-a comparative study, in: 2022 international conference on applied artificial intelligence (ICAPAI), IEEE, 2022.
[133] N.K. Rajagopal, et al., Future of business culture: an artificial intelligence-driven digital framework for organization decision-making process, Complexity 2022 (1) (2022) 7796507.
[134] N.M. Shanbhag, et al., Integrating artificial intelligence into radiation oncology: can humans spot AI? Cureus (12) (2023) 15.
[135] Y. Marquis, et al., Proliferation of AI tools: a multifaceted evaluation of user perceptions and emerging trend, Asian J. Adv. Res. Rep. 18 (1) (2024) 30–55.
[136] A. Martin-Boyle, et al., Shallow synthesis of knowledge in GPT-generated texts: a case study in automatic related work composition (2024) arXiv preprint.
[137] J. Liu, S. Li, Toward Artificial Intelligence-Human paired Programming: a review of the educational applications and research on artificial intelligence code-generation tools, J. Ed. Comput. Res. (2024) 07356331241240460.
[138] D.T. Reddy, et al., The role of artificial intelligence in healthcare: enhancing coronary computed tomography angiography for coronary artery disease management, Cureus (6) (2024) 16.
[139] M. Mostafapour, et al., Evaluating literature reviews conducted by humans versus ChatGPT: comparative study, Jmir Ai 3 (2024) e56537.
[140] Wyn Roberts, G., advancing new approaches to learning and teaching–introducing appreciative inquiry to a problem-based learning curriculum, J. Appl. Res. Higher Ed. 2 (1) (2010) 16–24.
[141] L.A. Chesson, et al., Stable isotopes in forensics applications (2014).
[142] Y. He, The weakness and strengthening of academic power in the university, in: 2015 International Conference on Industrial Technology and Management Science, Atlantis Press, 2015.
[143] T. Ma, et al., Topic based research competitiveness evaluation, Scientometrics 117 (2018) 789–803.
[144] F. Qasem, ChatGPT in scientific and academic research: future fears and reassurances, Library Hi Tech News 40 (3) (2023) 30–32.
[145] H. Zheng, et al., Learning from models beyond fine-tuning, Nat. Mach. Intell. (2025) 1–12.
[146] A. Alishev, Transfer learning and hyperparameter optimisation with convolutional neural networks for fashion style classification and image retrieval (2024).
[147] S. Schacht, S.Kamath Barkur, C. Lanquillon, Promptie-information extraction with prompt-engineering and large language models, in: International Conference on Human-Computer Interaction, Springer, 2023.
[148] N. Koul, Prompt Engineering for Large Language Models, Nimrita Koul, 2023.
[149] N. Rane, et al., Techniques and optimization algorithms in machine learning: a review, Appl. Mach. Learn. Deep Learn.: Architect. Tech. (2024) 39–58.
[150] B.K. Nagaraj, et al., The emerging role of artificial intelligence in STEM higher education: a critical review, Int. Res. J. Multidisciplinary Technovation 5 (5) (2023) 1–19.
[151] T.M. Khawaji, Best practices for implementing AI in STEM education: a systematic literature review, Int. J. Comput. Sci. Netw. Secur. 24 (8) (2024) 1–13.
[152] S. Farber, Enhancing peer review efficiency: a mixed-methods analysis of artificial intelligence-assisted reviewer selection across academic disciplines, Learned Pub. (2024) e1638.
[153] A.S. Ahuja, The impact of artificial intelligence in medicine on the future role of the physician, PeerJ. 7 (2019) e7702.
[154] R. Najjar, Redefining radiology: a review of artificial intelligence integration in medical imaging, Diagnostics 13 (17) (2023) 2760.
[155] Q. Pei, et al., Artificial intelligence in clinical applications for lung cancer: diagnosis, treatment and prognosis, Clin. Chem. Labor. Med. (CCLM) 60 (12) (2022) 1974–1983.
[156] I.S. Chua, et al., Artificial intelligence in oncology: path to implementation, Cancer Med. 10 (12) (2021) 4138–4149.
[157] M. Banerjee, et al., The impact of artificial intelligence on clinical education: perceptions of postgraduate trainee doctors in London (UK) and recommendations for trainers, BMC. Med. Educ. 21 (2021) 1–10.
[158] C. Cheligeer, et al., Natural language processing (NLP) aided qualitative method in health research, J. Integrated Design Process Sci. 27 (1) (2023) 41–58.

[159] R.P. Lennon, et al., Developing and testing an automated qualitative assistant (AQUA) to support qualitative analysis, Fam. Med. Community Health 9 (Suppl 1) (2021).
[160] H. Harrison, et al., Software tools to support title and abstract screening for systematic reviews in healthcare: an evaluation, BMC. Med. Res. Methodol. 20 (2020) 1–12.
[161] M. Moss, D. Thomas, T. Gollins, The reconfiguration of the archive as data to be mined, Archivaria 86 (86) (2018) 118–151.
[162] M.A. Chabin, The potential for collaboration between AI and archival science in processing data from the French great national debate, Records Manage. J. 30 (2) (2020) 241–252.
[163] R.L. Punzalan, M. Caswell, Critical directions for archival approaches to social justice, Libr. Q. 86 (1) (2016) 25–42.
[164] S.W. Aboelela, et al., Defining interdisciplinary research: conclusions from a critical review of the literature, Health Serv. Res. 42 (1) (2007) 329–346, 1 Pt.
[165] A. Badshah, et al., Transforming educational institutions: harnessing the power of Internet of things, cloud, and fog computing, Future Internet 15 (2023), https://doi.org/10.3390/fi15110367.
[166] A.U. Patel, et al., The crucial role of interdisciplinary conferences in advancing explainable AI in healthcare, BioMedInformatics 4 (2024) 1363–1383, https://doi.org/10.3390/biomedinformatics4020075.
[167] R. Liu, et al., HTA158 exploring efficiency of living systematic literature review (SLR) tool for submissions of clinical evidence to national institute for health and care excellence (NICE) by combining interventional and real-world evidence (RWE), Value Health 26 (12) (2023) S349.
[168] J. Clark, et al., The impact of systematic review automation tools on methodological quality and time taken to complete systematic review tasks: case study, JMIR. Med. Educ. 7 (2) (2021) e24418.
[169] O. Egunsola, et al., HTA40 living network meta-analysis for up-to-date comparative effectiveness: a case study in metastatic castration resistant prostate cancer (MCRPC), Value Health 26 (6) (2023) S265.
[170] N. Khan, et al., Global insights and the impact of generative AI-ChatGPT on multidisciplinary: a systematic review and bibliometric analysis, Conn. Sci. 36 (1) (2024) 2353630.
[171] Tsou, C., Implementing artificial intelligence (AI) in higher education: a narrative literature review. 2023.